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ABSTRACT

The relationship between skill demands, changing work organization, and performance was examined in a study of workers across 15 "benchmark" jobs in each of 8 public utilities. Skills issues were assessed by plant managers, workers, and their supervisors. Randomly selected managers/supervisors reported a series of performance measures for each employee. The response rate was 100% for supervisors and 85% for employees. A total of 91 supervisors responded, and there were 553 usable matched responses between supervisors and employees. Employees and supervisors alike considered basic academic or Foundation Skills (skills associated with more traditional, school-based education) more important than workplace competencies (more vocational/work-based skills). Foundation skills were deemed more important for improving performance than were workplace competencies, and deficits in foundation skills were associated with poorer overall job performance. The perceived need to improve foundation skills was associated with more positive attitudes and behaviors. It was further concluded that higher levels of the task-oriented aspects of jobs do seem to raise skill needs whereas the basic concepts associated with high-performance work systems do not. Interpersonal skills were the skills most stretched by both types of work organizations. (The survey instruments and tallied responses are appended. Contains 49 references.) (MN)

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Skill Demands, Changing Work Organization, and Performance

by

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by Peter Cappelli and Nikolai Rogovsky
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Abstract

The U.S. is engaged in an important policy debate about the contribution of workplace skills to economic performance, but there have been few efforts to test the propositions that are driving that debate. The arguments that follow, using the first empirical examination of the general workplace skills put forward by the Secretary's Commission on Achieving Necessary Skills (SCANS), conclude first that the most important negative effects on job performance come from deficiencies in academic or "Foundation" skills; second, performance is actually improved, in contrast, when workers feel that their skills are being stretched (short of a deficit), but again only for academic skills. Finally, employee participation and other practices associated with "high-performance" work systems do not in fact appear to demand higher skills from workers, although jobs that offer more "enriched" individual tasks do demand higher skills.

Skill Demands, Changing Work Organization, and Performance

Recent discussions about U.S. competitiveness have increasingly focused on the relationship between economic performance and the skills of the nation's workforce. Government policy now specifies skills that are important for new work systems and economic performance, advocating their introduction into schools and training programs. Unfortunately, there has been very little empirical research that examines general workplace skills. The discussion below presents new data from workers and their supervisors about the importance of various skills, their contribution to job performance, and the relationship between new systems of work organization—"high-performance" systems—and skill requirements.

Competitiveness and Skills

The current concern about skills and economic competitiveness began with the federal report *A Nation at Risk* (1984), which documented the poor academic performance of U.S. students compared to our competitor nations. Around the same time, Piore and Sabel (1984), Cohen and Zysman (1987), and others were drawing attention to the importance of production work to an economy and the fact that work organization and employee skills influenced the competitiveness of manufacturing firms and their ability to adapt to changing markets. Studies like Baumol et. al. (1989) reinforced the general concern with the long-run and comparative performance of the U.S. economy.

Dertouzos et. al. (1989) developed these views into an argument about declining U.S. competitiveness that became a virtual touchstone for future studies. He argued that the work organization and management structures of U.S. firms are hierarchical, based on narrow job titles and unskilled workers and, as a result, are not as flexible in adjusting to changing markets as are our competitors. More flexible and effective production techniques, such as those associated with Japanese management, also demanded higher skills from the labor force.

Other studies soon captured the connection between skills and performance. Both *America's Choice* (1990) and the reports of the Office of Technical Assessment (1990) argued that higher levels of skills in the workforce were necessary in order to develop new, more productive systems of work organization to compete successfully with other nations. The U.S. Department of Labor has taken a strong position advocating high-performance work systems (National Advisory Commission 1993; U.S. Department of Labor 1993), the U.S. Department of Commerce has created extension programs to disseminate knowledge about how to introduce these working practices—including training programs to raise worker skills—and President Clinton chaired a "town meeting" on the future of the workplace that focused on the relationships between skills, work systems, and competitiveness (Julian, Bentley, and Associates 1993).

Following these arguments, the Secretary of Labor's Commission on Achieving Necessary Skills (SCANS) was established in 1990 to identify the common skills that the workplace as a whole required of employees. In its various reports, the Commission has argued forcefully that new types of organizations and new arrangements for organizing work—employee empowerment, teams, and new work technologies—require new skills and a higher level of existing skills from workers. It also states that the required skills are at least in part general work skills that translate across employers and industries. According to these reports, both employers and individual workers are seen as benefiting from those higher skills (SCANS 1992).

Arguments like these have in large measure been responsible for a new thrust in public policy toward raising skill levels, especially through schooling. The creation of the National Goals for Education, for example, represents an effort to raise educational standards in the country at least in part to improve competitiveness. The list of skills identified by SCANS as being reasonably generic to the U.S. economy has been used to drive the curriculum in high schools and in training programs such as the Job Corps and those funded by the Joint Training Partnership Act (SCANS 1992, 1-4). Further, the recently passed "School-to-Work Opportunities Act," which will establish programs similar to youth apprenticeships, is also designed to raise work-related skills.

Skills and Individual Performance

Given the speed at which these arguments have moved forward, it is indeed surprising to find so little empirical research that examines general workplace skills. There have been no academic studies examining the SCANS skills and few attempts to consider the relationships that drive these policy arguments.

It is not obvious, for example, that higher levels of skills will necessarily lead to improved economic performance. Unless jobs require or allow workers to make use of higher skills, one should not expect performance to improve if skills increase. Further, jobs that now require higher levels of skills still may not tax the skills that employees already have. Hecker (1992) and Shelley (1992), for example, report evidence that a substantial proportion of the workforce has jobs that do not make use of their academic skills. In production jobs organized around scientific management, for example, the initial skill requirements are so low that

they could rise substantially and still be within the set that virtually all workers possess. Finally, the skills that are deficient may be job-specific ones that are typically seen as being the employer's responsibility to provide.

A few studies have examined relationships between broadly defined skills and the performance of organizations. Bartel and Lichtenberg (1987) find, for example, that the rate of innovation is higher in industries that have more educated workers. Cohen and Levinthal (1990) also find that firms that have made a greater investment in learning have a higher rate of innovation. However, studies like these are highly aggregated, so that it is difficult to tell much about the relationship between specific skills and performance. For that reason, attention focuses more on skills and performance at the level of the individual worker.

Perhaps the primary obstacle facing this research is the difficulty in obtaining direct measures of an employee's skill. Typically available are aggregate measures of the amount of education and training workers receive—the inputs that should produce skill—which are related to indirect measures of performance.

The body of research on the economic returns to education is particularly extensive. The human capital research clearly finds that employees with more education earn more, suggesting that the skills they have are valued in the market. Whether education is simply a proxy or "screen" for some other desirable characteristic, such as perseverance, is a factor that complicates the argument. The fact that returns to education appear to have risen over the past decade—rapidly for college graduates and falling sharply for high school dropouts—suggests that such education is increasingly valuable in the labor market (see Levy and Murnane 1992 for a survey).

But for which specific skills is the return to education being earned? Research has consistently found that doing well in school is not necessarily related to success on the job or in the labor market (Bishop 1989; Hunter and Hunter 1984). Studies on specific course content are only moderately more revealing. They find, for example, small returns to taking more math in college (James et. al. 1990).

Research on the relationship between vocational course work, which provides training for specific occupations, and subsequent job and labor market performance is only moderately more helpful. The recently completed *National Assessment of Vocational Education* (1994) concludes that vocational skills pay off when graduates find jobs in their field of training but not necessarily otherwise. This may indicate, for example, that the programs help simply by giving students access to a well-paying job market. In one of the few studies that attempts to sort out the source of higher wages, Grubb (1991) concludes that the return from a two-year college degree comes mainly from access to better paying occupations than those available to non-degree workers and are not the result of obtaining higher paying jobs within the same occupation. Grubb's study measures the extent to which education produces higher performance for the economy as a whole.

In order to determine whether education functions as a screening device that provides access to certain occupations in addition to improving performance within jobs, it is necessary to examine the effects of training received after employment. Surveys of training (Brown 1990; Lynch 1991; Lillard and Tan 1992) find that employer-provided training, especially on-the-job training, has the largest payoff in terms of future wage increases. But there is relatively little information in

most training surveys concerning the actual *content* of training and little research on its relationship with job performance, as opposed to labor market outcomes.[1]

SCANS conducted its own test of the relationship between skills and performance by examining the prevailing wages for a sample of jobs and the SCANS competencies associated with them (SCANS 1992, 9). They find, not surprisingly, that jobs requiring higher skills pay more. As noted above, however, it is not clear what to conclude from this fact. It does not indicate, for example, that workers perform better in the same job with higher skills or that the state of the economy would improve if skill levels rose.

A better way to examine the relationship between performance and skill is to measure an individual's skills directly—as opposed to their levels of education or training—and then to focus on the relationship with job performance. There are literally thousands of studies in personnel psychology examining the predictors of job performance, which consider an individual's background experiences ("biodata"), personality, skills specific to a particular job ("work samples"), as well as a range of other characteristics. The measures most closely related to the basic work skills that might generalize across work settings and that are the focus of the current policy debate are tests of cognitive and psychomotor aptitude, known collectively as "ability tests."

The two most widely used ability tests are the General Aptitude Test Battery ("GATB") and the Armed Services Vocational Aptitude Battery, both of which measure a range of aptitudes associated with traditional academic learning and psychomotor skills (e.g., coding speed). Reviews of this literature range from suggesting that these aptitudes are moderately successful at predicting job performance (e.g., National Research Council 1989) to being the best predictors available (e.g., Hunter and Hunter 1984). The components of these tests that measure general cognitive ability (intelligence; verbal and numerical aptitude in the GATB) are by far the best predictors of job performance (Hunter and Hunter 1984; Ree and Earles 1991; Schmidt et. al. 1992). Studies even show, for example, that general cognitive ability is a better predictor of training success than specific ability relating to the tasks being trained (see Welsh et al. 1990; Ree and Earles 1991).[2]

Proponents of ability tests suggest that their use could improve overall economic performance by making better matches between workers and jobs. Recent evidence also suggests that the labor market returns to cognitive abilities are rising (Murnane, Wilett, and Levy 1992). It is not as clear what they tell us about the relationship between *skills* and performance, however, in part because measuring aptitudes is not identical to measuring skill levels. In particular, the general cognitive ability measure, the most important predictor in these tests, appears to be driven in large part by intelligence, which cannot be taught in the same way that workplace skills are.

Overall, the results surveyed above suggest that job performance—and ultimately economic performance—might be improved by raising skills in the workforce as a whole. With respect to the policy arguments above, however, it is not clear which skills are important for performance.

Work Systems and Skill Requirements

The second issue driving the current policy discussion is the argument that skill needs in the economy are changing. In particular, new forms of more productive work organization require higher levels of skill from employees. These arguments suggest that high-performance work systems that give more responsibility to employees through teamwork and other forms of participation require more from them. Again, there is virtually no evidence to support this assertion.

The existing research suggests that changes in the distribution of employment across occupations may be raising average skill levels in the economy—albeit at a declining rate relative to the past (Howell and Wolfe 1992)—and that the skills required for production jobs in particular may be increasing (Cappelli 1993). But it is difficult to find anything other than anecdotal evidence concerning the relationship between new work systems and skill levels.

Two studies provide some indirect information. MacDuffie and Kochan (1993) find that among auto assembly plants those with "lean" production systems that require more decision making on the part of the employees also have human resource practices that include more extensive training. Osterman (1993) also finds that establishments with more aspects of "transformed" work systems (teams, job rotation, total quality management systems, and quality circles) have more extensive training programs.

The SCANS Skills

SCANS essentially performed a job analysis for the economy as a whole, producing a set of basic skills that are said to generalize across virtually all jobs in the workplace. While all job analyses are somewhat subjective, the SCANS skills are similar to those generated by other widely-used job analyses such as the Position Analysis Questionnaire (McCormick and Jeanneret 1988). SCANS identified two main categories of these general skills: "Foundation Skills" associated with traditional academic education and interpersonal skills and "Workplace Competencies" that are more practical and vocational, applying skills to a workplace context.

The publication of the SCANS skills and the effort to have these skills institutionalized in curricula creates a need to examine the general relationships concerning skills put forward in the policy debate. Are these skills related to actual performance? What is the relative importance of the different skills? Do the academic skills or the vocational skills have a bigger impact on performance? The results have powerful implications for the reform of education in the U.S., particularly curricular reform.

A second question is whether new systems of work organization associated with high-performance work are, in fact, creating a need for higher skills, and, if so, what are those skills? To our knowledge, there have been very few attempts—and none with the SCANS skills—to examine the relationship between general workplace skills and actual performance. In addition, there have been no efforts other than case studies to examine the relationships between new work systems and skill demands.

Data and Study Design

Eight public utilities agreed to cooperate in this study, which examined workers across 15 jobs in each company.[3] The companies identified the jobs to be examined, which were "benchmark jobs," common to all the companies and easily identifiable in the outside labor market. They span a range of positions, including craft, clerical, supervisory, and managerial work. The jobs are not necessarily unique to utilities, although we accept that the industry context may exert some unique influence on skill requirements. Specifically, public utilities are among the best-paying, most stable employers in their communities and may well have their pick of the best available workers with the highest overall level of skills, at least for nonexempt employees.[4] The employees may have higher skills than those elsewhere, and it is possible that the jobs are adjusted somewhat to make use of those higher skills.

Skills issues were assessed by plant managers, by workers, and by their supervisors. The managers and supervisors were chosen at random from within the companies. The supervisors were selected according to the benchmark jobs they oversaw, with one supervisor represented for each job. Each supervisor reported a series of performance measures for each employee. Where they supervised more than ten employees, they selected at random up to ten on whom they reported. We then surveyed the employees who were rated in terms of skill issues, work organization, and job attitudes. The response rate for supervisors was 100 percent (no doubt because their superiors ordered them to respond) and 85 percent for employees. A total of 91 supervisors responded, and there were 553 usable matched responses between supervisors and employees.

Analysis

Perceptions of Skill Needs

Employees were asked how important additional training in each skill area would be to improving their job performance. Table 1 lists the specific items in the SCANS skills framework and reports the employees' perception of the importance of those skills to improving performance on the job. The most important finding is that employees believe Foundation Skills—those associated with more traditional, school-based education—are significantly more important than Workplace Competencies, which represent more vocational or work-based skills. A nonparametric Wilcoxon test finds that the difference in rankings between these sets of skills is significant at the 5 percent level (two-tailed tests). Of the Workplace Competencies, the first three, which stress interpersonal skills, are seen as considerably more important than the others.

Table 2 asks the same question of supervisors about the skills their subordinates need. The supervisors believed that every skill was more important than did their subordinates, although the rankings of the relative importance of the skills in the two tables are remarkably similar.[5] One difference is that the margin by which Foundation Skills were seen as more important was substantially greater for the supervisors. A Wilcoxon test finds that the difference in rankings between the two sets of skills for supervisors is also significant at the 5 percent level.

The questions in Tables 1 and 2 ask about the skills that are necessary to improve job performance. In order to assess deficiencies in their subordinates' skills, the inquiry presented in Table 3 asks the supervisors a slightly different question, which may capture more accurately when employee skills are insufficient to meet minimum or required levels of performance. Here, the Workplace Competencies come out as significantly more important. The rank correlation (Spearman) between the supervisors' assessments of skill importance and skill deficits was -0.69 (significant at the 1 percent level), suggesting that the more important a skill is, the less deficient it is.

Table 1

Needs for training (perception of the importance of the training & development of the following skills) (1=very unimportant; 5=very important)					
Foundation Skills:	Mean	STD	Rank	Group Mean 3.8583	Group Rank 1
Basic reading & mathematical skills	3.8259	1.5312	5		
Communication skills--speaking, listening, writing	3.8428	1.1626	3		
Thinking skills--problem solving, reasoning, thinking creatively	3.9461	1.1621	1		
Personal qualities--responsibility & self-management	3.8182	1.1497	6		
Workplace Competencies:				3.5577	2
The ability to work with others	3.9383	1.1450	2		
The ability to work in teams	3.8305	1.1859	4		
The ability to teach	3.4684	1.2568	9		
The ability to allocate material, money, space or staff	2.9137	1.4322	11		
The ability to acquire & evaluate data, interpret & communicate findings from data	3.6656	1.2225	7		
The ability to understand systems of technology or organization, make changes & improve such systems	3.6317	1.2626	8		
The ability to select appropriate equipment and tools, apply to specific tasks	3.4561	1.3534	10		

Table 2

Supervisors' ranking of the importance of the following skills (1=very unimportant; 5=very important; n=91)					
Foundation Skills:	Mean	STD	Rank	Group Mean 4.5747	Group Rank 1
Basic reading & mathematical skills	4.4545	0.7529	5		
Communication skills--speaking, listening, writing	4.6623	0.6201	3		
Thinking skills--problem solving, reasoning, thinking creatively	4.6883	0.5907	2		
Personal qualities--responsibility & self-management	4.4935	0.7000	4		
Workplace Competencies:				4.0638	2
The ability to work with others	3.5844	1.2068	11		
The ability to work in teams	4.7272	0.6200	1		
The ability to teach	4.4473	0.8547	6		
The ability to allocate material, money, space or staff	3.8441	0.9041	9		
The ability to acquire & evaluate data, interpret & communicate findings from data	4.1818	0.8695	7		
The ability to understand systems of technology or organization, make changes & improve such systems	3.9605	0.8861	8		
The ability to select appropriate equipment and tools, apply to specific tasks	3.7013	1.1363	10		

Table 3

Supervisors' ranking of the deficiencies of their immediate subordinates' skills (1=outstanding; 5=very deficient; n=91)					
Foundation Skills:	Mean	STD	Rank	Group Mean 2.4894	Group Rank 2
Basic reading & mathematical skills	2.4675	0.8364	7		
Communication skills--speaking, listening, writing	2.6753	0.8950	3		
Thinking skills--problem solving, reasoning, thinking creatively	2.3947	0.8956	10		
Personal qualities--responsibility & self-management	2.3421	0.7925	11		
Workplace Competencies:				2.6530	1
The ability to work with others	2.6986	0.7938	2		
The ability to work in teams	2.4079	0.8355	9		
The ability to teach	2.4400	0.8889	8		
The ability to allocate material, money, space or staff	2.8947	0.8881	1		
The ability to acquire & evaluate data, interpret & communicate findings from data	2.4933	0.8443	6		
The ability to understand systems of technology or organization, make changes & improve such systems	2.6710	0.8064	4		
The ability to select appropriate equipment and tools, apply to specific tasks	2.5733	0.7914	5		

Plant managers were also asked about the deficiencies of their employees. Their responses are reported in Table 4. Foundation Skills were reported to be in greater deficit for both new hires and veteran workers, while both Foundation Skills and Workplace Competencies are considered to be in greater deficit for "veteran" workers than for new hires. Short of some rapid improvement in the skills that entry-level workers have brought to their jobs during the past two years, these results appear to suggest that skill deficits are more noticeable once workers have been in their jobs for awhile. This situation may be due to an increase in the demands made of employees as they accrue time with their employers. The fact that the deficits become relatively greater for Foundation Skills implies that those skills may be put to greater use after one has been on the job.

Each employee also reported the percentage of time devoted to the SCANS skills during the formal training programs they attended. The rank (Spearman) correlation between the distribution of time spent in training programs and skill importance as reported by supervisors was .70 (significant at the 1 percent level); the correlation with skill deficits reported by supervisors was -.45 (significant at the 10 percent level). It may be a rational strategy to devote training resources to the most important skills, but these results also suggest that the current distribution of training may do little to overcome skill deficits.

Skill Deficits and Individual Performance

The next analysis examines the relationship between these skill measures and individual performance. The performance measure is a single item asking the supervisor about "the overall performance of this employee" as compared to others that the supervisor has managed over the past ten years. (The ten-year comparison reduces the tendency to make each evaluation relative to the supervisor's current group of employees, which would essentially impose the same distribution on each workgroup). The skill measures are the supervisors' assessments of skill deficits

Table 4

Plant Manager Survey (n=95) Question: What deficiencies do you see in the employees (1=no deficiencies; 5=serious deficiencies) Means

	Foundation Skills	Workplace Competencies
"New Hires" (employees with less than 2 years service)	2.17	2.15
"Veterans" (employees with at least 2 years service)	2.42	2.26

summarized in Table 3. Skill deficits—situations in which jobs require skills that workers do not have—represent a problem that should have an adverse effect on current performance.

Table 5 identifies the variables used in the analysis of skill deficits and performance.[6] "Skills Deficiencies" represents the overall score for the SCANS scale as a whole, while the Foundation and Workplace Competencies variables represent the score for each subsection of the overall scale.

The results in Table 6 suggest that there is a strong relationship between overall skill deficits and performance. The second equation suggests that this overall result is driven by deficits in Foundation Skills and not Workplace Competencies. The argument that the relationship between overall skill deficiencies and performance could be driven by common method variance (i.e., supervisors who believe that their workers perform poorly also report that those workers perform poorly in every way, perhaps as a way to justify poor performance scores by reporting even worse deficits) is not consistent with the results in the second equation. Supervisors are not reporting greater deficits in Workplace Competencies where performance is worse. Indeed, the sign is in the opposite direction.[7]

Skill Needs and Work Organization

The policy arguments outlined above suggest that new work systems in particular are creating a greater demand for skills. The responses from individual employees in this survey provide information about the extent of innovative work practices—especially employee participation and teamwork, which characterize high-performance work systems—and are used to examine the relationship between work systems and the demand for additional skill. We are testing to see whether these work organization practices are associated with the employee's perceptions of skill needs.

The column headings in Table 7 list questions that examine work organization practices. The Job Diagnostic Survey (JDS), for example, has arguably been the main instrument used in personnel psychology to examine how individual jobs are performed by defining the characteristics of the specific tasks (see Hackman and Oldham 1980). Jobs that rank higher on this scale are thought to meet better individual workers' psychological needs and improve their performance.[8] The kind of task-oriented job design measured by the JDS formed the basis of the dominant model for work reform in the 1970s.

Previous research has consistently found that jobs with higher scores on the JDS also score higher on job evaluations that measure job requirements (Hackman and Lawler 1971; Campion and Berger 1990; Dunham 1977 uses the PAQ job evaluation discussed earlier, which is similar to the SCANS scale). However, job evaluations assess other compensatible factors such as accountability and responsibility in their scores as well as skill requirements, which may make it difficult to draw clear conclusions about the relationship between skill requirements *per se* and task characteristics from this literature. Both the overall JDS scale and the five separate items of the scale are examined here.

The other questions identified in Table 7 ask about the extent of employee and team influence and related personnel practices. These questions capture the aspects of work that Osterman (1993) and others see as being central to high-performance work systems—the institutional characteristics of employment systems rather than the characteristics of individual tasks.

It is not obvious *a priori* whether high-performance work systems will require higher skills. For example,

Table 5

Means and Standard Deviation of the Variables Used in the Models		
	Mean	Std
Age (years)	44.14	54.22
Level of education (1=some high school; 6=four year college)	3.66	1.51
Sex (1=male; 2=female)	1.24	0.45
Time spent at present company (years)	15.00	9.27
Age when one began working full time (years)	19.76	3.87
Size of work group (number of employees)	5.82	2.91
Skills' deficiencies (1=outstanding; 5=very deficient)	2.56	0.63
The foundation skills' deficiencies (1=outstanding; 5=very deficient)	2.49	0.71
The workplace competencies' deficiencies (1=outstanding; 5=very deficient)	2.65	0.64
Performance (1=very poor; 5=very good)	3.71	0.52

Table 6

Regression Coefficients. Dependent Variable - Performance		
	Equation 1	Equation 2
Age (years)	0.0001 (0.35)	0.0005 (0.20)
Level of education (1=some high school; 6=four year college)	0.0100 (0.73)	0.0125 (0.93)
Sex (1=male; 2=female)	0.0089 (0.21)	-0.0317 (-0.73)
Time spent at present company (years)	0.0068** (2.32)	0.0072** (2.54)
Age when one began working full time (years)	-0.0061 (-1.27)	-0.0071 (-1.51)
Size of work group (number of employees)	0.0319*** (2.88)	0.0347*** (3.20)
Skills' deficiencies (1=outstanding; 5=very deficient)	-0.2051*** (-6.56)	
The foundation skills' deficiencies (1=outstanding; 5=very deficient)		-0.2641*** (5.85)
The workplace competencies' deficiencies (1=outstanding; 5=very deficient)		0.0595 (1.24)
F-value	8.97	10.67
R-square-adj.	.14	.18
n	91	91

*p < .1
**p < .05
***p <.01

working in teams may require additional interpersonal skills when compared to situations in which an employee primarily works alone. But teams are also a means of economizing other skills. When the group as a whole makes decisions, no one individual needs to have all of the necessary expertise or skill themselves; it is sufficient for all of the necessary components of skill or knowledge to be distributed among individuals in the group. It might not be unusual, for example, to find that workers in teams may need a significantly lower number of specific skills, when compared to the greater number of skills required when individuals perform complex tasks entirely alone.

Employees report the extent to which their own work experience conforms to the descriptions of job design and work organization posed by these questions along a five-point Likert scale. Workers reporting a 1 or 2 on these questions see little enrichment or empowerment. They are coded as being "Low" for that item. Their reports of skill needs for the SCANS items (described earlier) are then compared to workers who score 4 or 5—responses that are coded as being "High" for that item. Workers scoring a 3 on these questions are omitted in a deliberate attempt to examine the more extreme situations represented by these codes. Difference of mean tests are reported that compare the skill-need responses of workers coded as Low and as High for each work organization question.[9]

The results in Table 7 suggest that "enriched" individual tasks associated with higher overall JDS scores are associated with significantly higher overall levels of skill needs; the relationships are also higher for half of the SCANS skills considered independently. This result does not hold for each of the five facets of job design taken separately, however. The skills that are significantly higher center around interpersonal skills. It is not surprising that the "Feedback" facet ("to what extent does the job itself provide you with information about your work performance") represents the exception in terms of skill needs; jobs with higher feedback are associated with needs for greater data and technology skills. The explanation may be that higher skills are needed by definition to analyze feedback.

In contrast, only one of the six questions assessing employee influence shows a positive overall relationship with higher skills. Greater information sharing, performing duties in crews or work teams, and pay collaboration (which reinforces a team orientation) show no relationships with skill needs. Some individual skill needs are in fact significantly *lower* when these aspects of work organization are greater. High levels of influence over how work is allocated among available workers seems to be associated with the largest increases in skill needs. The skills that appear to be most in need of improvement when workers experience high levels of these work organization factors again appear to be interpersonal skills—working with others, working in teams, and teaching skills.

Overall, the nature of the tasks that individual workers perform is associated with a significant need for greater skills, but the broader institutions and organization of work—decision making and teamwork—are not. It is possible, of course, that these practices do in fact demand higher skills from the employees but that the employees already have the additional skills needed to carry them out. As a result, the employees did not experience any shortfall in skills and did not report a need to improve their skills.[10]

Table 7 Means Comparisons t-test. Two-tailed test.

	Job Diagnostic Survey (1=very unimportant; 5=very important)		How much autonomy is there in your job? (1=very little; 5=very much)		To what extent does your job involve doing a "whole & identifiable piece of work?" (1=my job is only part of the work; 5=my job involves doing a whole piece of work from start to finish)		How much variety is there in your job? (1=very little; 5=very much)	
	Low	High	Low	High	Low	High	Low	High
General	3.4728	3.6397**	3.5582	3.6386	3.5855	3.6311	3.6494	3.8014**
Basic reading & mathematical skills	3.0206	2.7697*	2.9340*	2.7463	2.8745	2.7614	2.8028	2.7073
Communication skills--speaking, listening, writing	3.7373	3.8866	3.7828	2.9031*	3.8185	3.8965	4.1006	4.1336
Thinking skills--problem solving, reasoning, thinking creatively	3.8787	3.9866	3.9545	3.9743	3.9845	3.9515	4.1538	4.1837
Personal qualities--responsibility & self-management	3.7676	3.8661	3.8173	3.8657	3.8217	3.8719	4.1622	4.0855
The ability to work with others	2.4639	3.0959***	2.7344	3.1195***	2.8498	3.0992***	2.5896	3.1991***
The ability to work in teams	3.8673	3.9955	2.9187	4.0028	3.9651	3.9792	4.1402	4.2331
The ability to teach	3.6969	3.8908*	3.7070	3.9400**	3.8185	3.8893	3.8954	4.2206***
The ability to allocate material, money, space or staff	3.2959	3.5367*	3.3909	3.5514*	3.4535	3.5294	3.4173	3.8724***
The ability to acquire & evaluate data, interpret & communicate findings from data	3.6224	3.7232	3.6581	3.7314	3.7403	3.6736	3.8839	3.9323
The ability to understand systems of technology or organization, make changes & improve such systems	3.5816	3.7158	3.6989	3.6876	3.6836	3.6989	3.8759	3.9735
The ability to select appropriate equipment and tools, apply to specific tasks	3.2424	3.5471**	3.5228	3.4741	3.4086	3.5659**	3.5580	3.7154

Table 7 (continued) Means Comparisons t-test. Two-tailed test.

	How significant or important is your job? (1=not very significant; 5=highly significant)		To what extent does doing the job itself provide you with information about your work performance? (1=very little; 5=very much)		What type of influence do you have on the decisions related to your work schedule? (1=no say; 5=formal)		What type of influence do you have on the decisions related to how work is allocated among available workers (1=no say;5=formal)	
	Low	High	Low	High	Low	High	Low	High
General	3.5439	3.8063**	3.5476	3.6619**	3.5927	3.6257	3.5247	3.6780**
Basic reading & mathematical skills	2.5747	2.7907	2.8306	2.8014	3.9962**	2.6400	2.9215	2.7281
Communication skills--speaking, listening, writing	4.0326	4.1459	3.8406	3.8758	3.7753	3.9397**	3.6857	4.000***
Thinking skills--problem solving, reasoning, thinking creatively	4.1250	4.1868	3.9083	4.0168	3.9288	4.0035	3.8319	4.0756***
Personal qualities--responsibility & self-management	4.0230	4.1364	3.8127	3.8784	3.8120	3.8826	3.7777	3.9046
The ability to work with others	2.500	3.1204***	2.8739	3.0726	2.8154	3.1382***	2.7058	3.2020***
The ability to work in teams	3.9208	4.2799***	3.9640	3.9797	3.9323	.4.0107	3.8729	4.0528
The ability to teach	3.7579	4.2030***	3.7815	3.8123	3.7753	3.9324*	3.7090	3.9737***
The ability to allocate material, money, space or staff	3.3158	3.8039***	3.4320	3.5454	3.4361	3.5480	3.3729	3.5907**
The ability to acquire & evaluate data, interpret & communicate findings from data	3.8947	3.9202	3.5960	3.7972**	3.7218	3.6893	3.7008	3.7086
The ability to understand systems of technology or organization, make changes & improve such systems	3.8780	3.9561	3.8840	3.7830**	3.6818	3.7010	3.6090	3.7583
The ability to select appropriate equipment and tools, apply to specific tasks	3.3846	3.7420**	3.3546	3.6088***	3.6151**	3.3750	3.5578	3.4389

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Table 7 (continued) Means Comparisons t-test. Two-tailed test.

	What type of influence do you have on the decisions related to equipment to use for job (1 = no say;5 = formal)		What type of influence do you have on the decisions related to promotion decision of co-workers (1 = no say;5 = formal)		Influence one's work group has in the work-related decisions (1 = no influence;4 = a lot of influence)		Freedom to make work-related decisions on one's own (1 = need permission from supervisor;5 = free to act on one's own)	
	Low	High	Low	High	Low	High	Low	High
General	3.5592	3.6307	3.5853	3.6719	3.5705	3.6352	3.6069	3.6126
Basic reading & mathematical skills	3.0312**	2.7236	2.8974**	2.600	2.9163	2.7477	2.8771	2.7451
Communication skills--speaking, listening, writing	3.8827	3.8501	3.8075	3.9935*	3.8156	3.8885	3.7812	3.9463*
Thinking skills--problem solving, reasoning, thinking creatively	3.9691	3.9663	3.9213	4.0844*	3.9769	3.9607	3.9407	3.9961
Personal qualities--responsibility & self-management	3.8012	3.8678	3.8295	3.8961	3.8341	3.8575	3.8432	3.8538
The ability to work with others	2.6879	3.1032***	2.8094	3.4145***	2.7047	3.1600**	2.9500	3.0156
The ability to work in teams	3.9441	3.9844	3.9491	4.0325	3.9078	4.0151	3.9547	3.9923
The ability to teach	3.6852	3.9274**	3.8046	3.9870*	3.7235	3.9426**	3.8571	3.8544
The ability to allocate material, money, space or staff	3.3086	3.5714***	3.4492	3.6078	3.4166	3.5438	3.5540	3.4269
The ability to acquire & evaluate data, interpret & communicate findings from data	3.7777	3.6745	3.7023	3.7124	3.6805	3.7212	3.6713	3.7423
The ability to understand systems of technology or organization, make changes & improve such systems	3.6296	3.7180	3.6905	3.6948	3.6977	3.6879	3.6398	3.7490
The ability to select appropriate equipment and tools, apply to specific tasks	3.3951	3.5326	3.5485*	3.3464*	3.5602	3.4468	3.6062**	3.3643

*p < .1
**p < .05
***p < .01

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Skill Needs and Worker Outcomes

What happens to performance if workers find that they need more skills—for example, if the characteristics of their tasks change and produce greater skill needs? Having an unmet need for skill may contribute to poor attitudes and performance, since it may be perceived as a break in a psychological contract with the employer or, more generally, as an inequity that the employer has not addressed. It is also possible, however, that skill needs are indications that jobs are changing in ways that create more challenge and stimulation, something that employees may see as desirable.

We examined the relationship between skill needs and job satisfaction, employee commitment, and "Organizational Citizenship Behavior" for each employee.[11] Satisfaction and commitment are important attitudes that one might expect would be affected by unmet needs (a broken psychological contract or inequity) or by new challenges. Citizenship represents an employee behavior that is especially crucial to work systems with reduced supervision and greater autonomy. It is also thought to be closely related to employee work attitudes. The satisfaction scale used is the Minnesota Job Satisfaction Index (Gibson et al. 1970), and the commitment scale is from Mowday et al. (1979). Both are self-reported. The citizenship scale is a shortened version of the one introduced by Podsakoff and MacKenzie (1989) and is reported for each employee by their supervisor. Cronbach Alpha coefficients for reliability are .84, .83, and .78, respectively. The scales are reported in the Appendix.

The relationships between skill needs and these dependent variables are examined in equations that include controls for various individual characteristics and jobs. The results, depicted in Table 8, suggest that workers who report that they need more skills have significantly *higher* satisfaction, commitment, and citizenship, suggesting that needing skills to improve performance (as opposed to skill deficits examined in Table 6) has positive effects on employee attitudes and behavior. When examining the two skill sets separately, however, the significant relationships are all with Foundation Skills.

Tests for causality using reverse regressions (available on request) suggest that skill needs are driving these outcomes and not the reverse. In other words, the positive relationship does not appear to be that "better" workers (more satisfied and committed with higher citizenship) are more likely to report skill needs because they are more interested in improving performance.

Finally, it is important to remember that the skill needs variable is not a measure of skill deficit. It measures only needs associated with improving performance, even if the current level may already be above acceptable. These results do not indicate that skill crises are good for employers. Rather, they suggest that workers respond well to jobs that challenge their Foundation Skills.

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Table 8 Skills Needs

	REGRESSION COEFFICIENTS Dependent Variables					
	Organizational Citizenship Behavior (OCB)		Organizational Commitment		Job Satisfaction	
	(1)	(2)	(1)	(2)	(1)	(2)
Intercept	2.7862*** (15.71)	2.7855*** (15.71)	2.8568*** (14.97)	2.8558*** (14.98)	2.7195*** (16.26)	2.6842*** (16.09)
Age	-0.0004 (-0.81)	-0.0004 (-0.75)	-0.0008 (-1.60)	-0.0008 (-1.53)	-0.0014*** (-3.20)	-0.0014*** (-3.14)
Level of education	0.0366** (2.14)	0.0386** (2.25)	0.0254 (1.38)	0.0281 (1.52)	0.0360** (2.19)	0.0416** (2.57)
Sex	0.1632*** (2.80)	0.1527*** (2.59)	0.2087*** (3.32)	0.1943*** (3.07)	0.1444*** (2.63)	0.1326** (2.39)
Time spent at present company	0.0067** (2.29)	0.0064** (2.18)	0.0060* (1.93)	0.0057* (1.80)	0.0087** (2.30)	0.0071** (2.58)
Company A (Dummy)	0.7161*** (6.08)	0.7150*** (6.07)	0.7212*** (5.69)	0.7197*** (5.68)	0.5434*** (4.89)	0.5675*** (5.12)
Company B (Dummy)	0.2917** (2.41)	0.2944** (2.44)	0.2283* (1.75)	0.2320* (1.78)	0.3097*** (2.73)	0.3247** (2.85)
Company C (Dummy)	0.2670** (2.22)	0.2672** (2.22)	0.2826** (2.18)	0.2829** (2.19)	0.1135 (1.01)	0.1180 (1.04)
Company D (Dummy)	0.5274*** (4.28)	0.5281*** (4.23)	0.5413*** (4.08)	0.5423*** (4.09)	0.5436*** (4.66)	0.5763*** (4.97)
Company E (Dummy)	0.3350*** (2.69)	0.3326*** (2.67)	0.3625*** (2.71)	0.3594*** (2.69)	0.2588** (2.21)	0.2572** (2.20)
Company F (Dummy)	0.2494 (2.06)	0.2447** (2.02)	0.2613** (2.01)	0.2548* (1.96)	0.1228 (1.07)	0.1520 (1.33)
Company G (Dummy)	0.1350 (0.96)	0.1427 (1.02)	0.0778 (0.52)	0.0884 (0.59)	0.2403** (1.82)	0.2664** (2.02)

Table 8 (continued)

	REGRESSION COEFFICIENTS (cont'd) Dependent Variables					
	Organizational Citizenship Behavior (OCB)		Organizational Commitment		Job Satisfaction	
	(1)	(2)	(1)	(2)	(1)	(2)
Company H (Dummy)	-0.0714 (-0.60)	-0.0711 (-0.60)	-0.1399 (-1.09)	-0.1394 (-1.09)	0.1359 (1.21)	0.1290 (1.15)
General perception of the importance of training	0.0759*** (2.69)	--	0.0658** (2.17)	--	0.0558** (2.11)	--
Perception of the importance of the training aimed at the development of:						
The foundation skills	--	0.1001*** (2.64)	--	0.0982** (2.57)	--	0.0863** (2.35)
The workplace competencies	--	-0.0072 (-0.01)	--	-0.0092 (-0.26)	--	-0.0098 (-0.29)
R-sqr.-Adj.	0.14	0.15	0.15	0.15	0.12	0.12

* = p < .1
** = p < .05
*** = p < .01

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Conclusion

The considerable attention given to potential relationships between skills, changing work organization, and economic performance has yet to be met by an equivalent outpouring of research on these relationships. The analysis presented here is one of a very few of such efforts. It indicates in particular the importance of basic academic or Foundation Skills to job performance. They are perceived as more important for improving performance by both employees and supervisors, deficits in them are associated with poorer overall job performance, and the perceived need to improve these skills is associated with more positive attitudes and behaviors.

The central relationship between Foundation Skills, work attitudes, and job performance found here seems consistent with the central role that cognitive ability—general cognitive ability in particular—has been found to play in job performance. It could well be that the results found here are driven in part by a basic relationship between Foundation Skills and general cognitive ability, in other words that the Foundation Skill variables measure something about general cognitive ability.

The results also suggest that work organization has an ambiguous effect on skill needs. Higher levels of the task-oriented aspects of jobs that were the focus of job redesign efforts in the 1970s do seem to raise skill needs, but higher levels of worker empowerment and teamwork, the basic concepts associated with high-performance work systems, do not. And the skills that are the most stretched by both types of work organization are interpersonal skills.

It is important to understand the limits of this study. Because we examine only current employees, the range of skill deficits and needs is left-censored: people with very poor skills are never hired and are therefore excluded from the sample. Further, while the jobs in this sample span a wide range of those in the economy as a whole, the public utilities industry is not representative of industry in the broader economy. The fact that these are large, stable companies with above-average pay (for nonexempt jobs) may mean that they can

recruit and retain better employees with higher skills. If so, then the range of skill deficits and needs of employees here is restricted, even when compared to employees in other companies. The skill deficits and needs reported here may all be relative to a high and acceptable base. The relationships reported for deficits in Table 6 might therefore be greater in the population as a whole, and the relationships for skill needs in Table 8 may not be significantly positive in a population for which skill needs are much greater relative to acceptable levels.

Similarly, public utilities may not have as extensive a range of high-performance work systems as do industries such as manufacturing. It is possible, for example, that extensive employee involvement along the lines of completely autonomous work teams would demand skills that the workers in this sample do not have. On the other hand, while the level of these programs may be lower here than in some other industries, the rhetoric in the industry suggests that the recent pace of change may be faster here than elsewhere, perhaps to catch up with the rest of industry. The difference in perceptions between workers who perceive "low" and "high" levels of job enrichment or employee involvement may in fact be greater in this sample than in other industries. The results in Table 7, therefore, could also be biased upward.

In terms of the policy arguments noted earlier, the results here support arguments suggesting that improving the skills of the workforce—the basic Foundation Skills in particular—can improve job performance. And jobs that challenge the basic academic or Foundation Skills of workers do not necessarily lead to performance problems. Indeed, they could stimulate employee performance. The results also suggest that more attention should be paid to interpersonal skills especially in the context of work reform.

The relationships with work systems reported here do call into question the basic argument in much of the policy literature that high-performance work systems make greater demands on worker skills. Concerns about inadequate skills may not necessarily be impediments to introducing workplace reform. Indeed, changes that challenge worker skills—short of creating outright deficits—may actually improve their performance.

Endnotes

[1] There are literally hundreds of separate studies validating the effects of specific training interventions in personnel psychology, but because these studies are not designed to be consistent, it is difficult to draw conclusions across them. A recent survey by Cascio (1994) suggests that different skills have effects on different aspects of performance and that making a good "fit" between these factors is the important issue.

[2] These relationships do not always extend to labor market outcomes, however. Bishop's (1992) comparison of workers' starting wages with their scores on the Armed Services Vocational Aptitude Battery finds that higher abilities were not associated with higher starting wages, although they were with wages five years later. Basic academic competencies such as math ability actually received a negative premium from the labor market while vocational skills such as typing speed earned a substantial premium.

[3] The original list contained 10 jobs. Despite the fact that the companies themselves prepared the list of benchmark jobs, not every company had every job on the list. Therefore, five additional job titles were included to cover positions at those companies with missing jobs. The new jobs were similar in content to the ones that were missing. The average company reported on 11 jobs, which explains why there are 91 supervisors surveyed and not 120—15 jobs at 8 companies.

[4] In 1992 the unemployment/employment ratio for these public utilities was .28, compared with .080 at the national level: median weekly earnings for production workers in public utilities were $615 compared with the average of $424 (source: "Employment and Earnings," January 1993). Compensation surveys for managers and executives, on the other hand, suggest that these jobs pay less in public utilities than in other industries.

[5] The one exception is the supervisors' ranking of "the ability to work with others" which they rank as eleventh in importance even thought they rank "the ability to work in teams" second in importance. Perhaps the supervisors see working with others as relationships that occur outside of the team they supervise, or perhaps these relationships are seen as secondary to the work effort and predominantly social in nature. The Rank correlation (Spearman) between the employee and supervisor responses was .51, significant at the 10 percent level.

[6] While the performance measures were requested for each employee, the skill deficits were asked of the group of employees that the respondent directly supervised. In most cases, the supervisor reported on all of their employees, so this group measure is the average score for the employees whose performance is evaluated.

[7] We also examined this relationship with the performance measure and the other independent variables aggregated to the group level consistent with the skill deficit measure. The results of weighted least square regressions are virtually the same despite the smaller sample size (n=91). Ordered probit estimates of the relationships in Table 6 are available on request.

[8] The voluminous research using the JDS finds strong support for associations with satisfaction but weaker relationships with performance (see Roberts and Glick 1981). There are also criticisms of the self-reported responses on which the JDS relies. The social information processing approach, for example, suggests that such responses depend on social cues as well as the objective characteristics of the tasks being performed (see Thomas and Griffen 1983).

[9] This method does not, of course, control for other differences that might be associated with these work organization issues. One reason for not attempting to control for them is that it is difficult to know which factors are truly exogenous to a fundamental issue such as work organization. It may also be irrelevant if the goal is simply to see whether skill needs are higher in situations in which these practices exist. We have, however, examined skill needs with a series of regressions (available on request) that control for individual characteristics, company, and job title. None have much of a relationship with skill needs. The overall regression models are very weak, although the basic pattern of relationships with work organization reported here still holds.

[10] A third possible explanation could hinge on the distribution of employee skills across jobs. If workers with lower skills are assigned to jobs that make less use of these systems, while higher skilled workers are assigned where these practices are more intensive, the reports of skill needs would be biased away from finding a positive relationship with work practices. The regression results noted in footnote 8, however, find no relationship between the usual proxies for skill (education, work experience, and job tenure) and reported skill needs nor any difference in their distribution across work systems.

[11] We also examined the relationship with the overall performance measure reported in Table 6, but the theoretical relationship here is conceptually unclear because the skill need questions are asked in the context of improving performance. Poor performers may see the greatest need to improve their performance; alternatively, good performers who are most interested in becoming better may report the greatest skill needs. Either effect may obscure potential relationships with skill needs *per se*. The results, available on request, show no relationship between skill needs and performance and a very weak overall model. Perhaps the two effects noted above cancel out each other.

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Appendix

Job Satisfaction

Q: "On my present job, this is how satisfied I am with the following issues (1=strongly agree, 5=strongly disagree)":		
	Mean	STD
Being able to keep busy all the time	4.2473	0.9092
The chance to work alone on the job	4.0507	0.9531
The chance to do different things from time to time	3.8863	1.0874
The chance to be "somebody" in the community	3.3248	1.0228
The way my boss handles his/her subordinates	3.3831	1.2210
The competence of my supervisor in making decisions	3.6241	1.1659
Being able to do things that don't go against my conscience	3.9185	0.9746
The way my job provides for steady employment	4.4532	0.8487
The chance to do things for other people	3.8897	0.8473
The chance to tell people what to do	3.4338	0.8521
The chance to do something that makes use of my abilities	3.7932	1.0408
The way company policies are put into practice	2.7365	0.9987
My pay and the amount of work I do	3.3971	1.1288
The chances for an advancement on this job	2.7039	1.2625
The freedom to use my own judgment	3.7243	0.9917
The chance to try my own methods of doing the job	3.6799	0.9818
The working conditions	3.6601	1.0644
The way my co-workers get along with each other	3.3975	1.1176
The praise I get for doing a good job	3.1121	1.1205
The feeling of accomplishment I get from the job	3.6866	1.0302
The amount of training you have received since working at this company	3.3748	1.1605
The quality of training programs offered by your company	3.2914	1.1027
The safety level at your workplace	4.0451	0.9218
The quality of safety training offered by your company	3.7255	0.9914
Employee/management relations at your company	2.9011	1.1082

Appendix

Organizational Commitment

Q.: "The following statements ask for views you have about your company. For each statement please indicate how much you agree or disagree by circling the numbered response (1=strongly disagree, 5=strongly agree):"		
	Mean	**STD**
I am willing to put in effort beyond that normally expected in order to help the company be successful	4.3417	.7771
I talk up the company to my friends as a great organization to work for	3.8276	1.0102
I feel very little loyalty to the company (R)	1.9658	1.1994
I find that my values and the company's are similar	3.3009	1.0150
I am proud to tell others that I am a part of the company	3.8921	1.0254
I could just as well be working for a different organization as long as the work is similar (R)	2.9047	1.1374
This company really inspires the best in me in the way of job performance	3.0628	1.0617
I am extremely glad that I chose to work here over any other place	3.7176	.9648
There's not too much to be gained by sticking with this company indefinitely (R)	2.1149	1.1080
I really care about the fate of the company	4.4416	.7531
For me, this is the best of all possible organizations to work for	3.4622	1.0382
Deciding to work here was a definite mistake on my part (R)	1.4668	.8360

Note: An "R" denotes a negatively phrased and reverse scored item.

Appendix

Organizational Citzenship Behavior

Q: "As compared to other employees that you have supervised - now and in the past - please evaluate this employee (1=strongly agree, 5=strongly disagree)":		
	Mean	**STD**
Consumes a lot of time complaining (R)	1.5568	.7999
Tends to make "mountains out of molehills" (R)	1.6282	.8019
Is always ready to lend a helping hand to those around him/her	2.7715	1.2722
Helps others who have been absent	2.6558	1.2481
Willingly helps others who have work related problems	2.7636	1.3231
Always focuses on what's wrong, rather than the positive side (R)	1.6958	.8623
Attendance at work is above the norm	2.7251	1.2607
Does not take extra breaks	2.7129	1.2717
Is one of my most conscientious subordinates	2.6333	1.2528

Note: An "R" denotes a negatively phrased and reverse scored item.

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